THEORETICAL STUDY OF RESONANCE ELASTIC SCATTERING OF THERMAL NEUTRONS ON ATOMIC NUCLEI

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Experimental cross sections for elastic scattering of thermal neutrons on atomic nuclei [1-3] have clearly pronounced maxima for some nuclei, for example, for ^{58}Ni. To explain this effect, the cross sections for elastic scattering of thermal neutrons on a wide set of nuclei have been calculated by numerical solution the Schrödinger equation. The experimental data are explained based on the concept of virtual levels [4]. It is shown that for the nuclei, for which the elastic scattering cross sections increase sharply, the energies of the *s*-levels of neutrons in the nuclear mean field go to zero.

The calculated radial probability densities for the *s*-states of thermal neutrons upon elastic scattering on the ^{28}Si and ^{58}Ni nuclei are shown in Fig. 1. The two maxima for silicon correspond to the low-lying 2*s*-state, three maxima for nickel correspond to the virtual 3*s*-state. The sharp change in the wave function when going from ^{28}Si to ^{58}Ni explains the resonance nature of elastic scattering of thermal neutrons on the ^{58}Ni nuclei with a cross section of 25 barns, which is an order of magnitude higher than the cross section for ^{28}Si (2 barns). Thus, it is shown that the resonance at the virtual *s*-level with an energy close to zero leads to a sharp increase in the elastic scattering cross section.

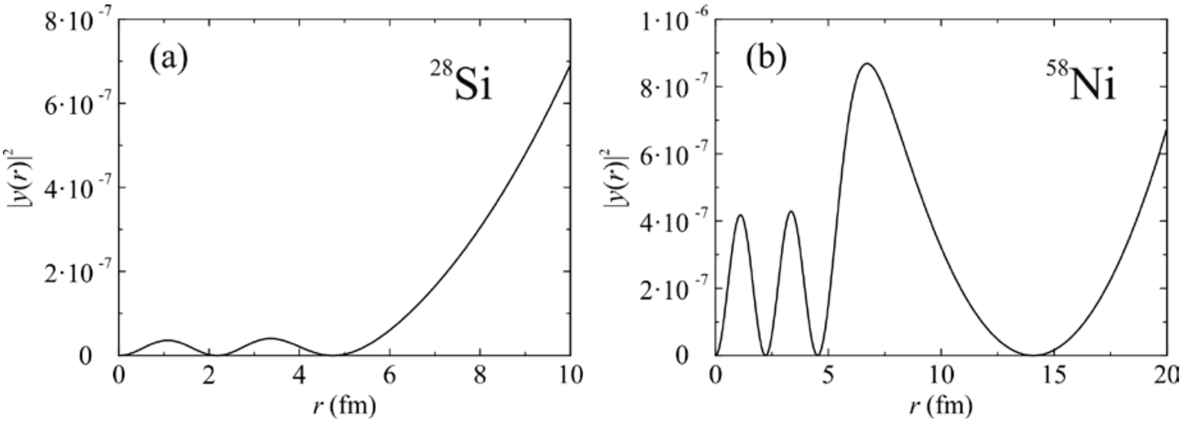

Fig. 1. Radial probability densities for the *s*-states of thermal neutrons upon elastic scattering on the ^{28}Si (a) and ^{58}Ni (b) nuclei.

References

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